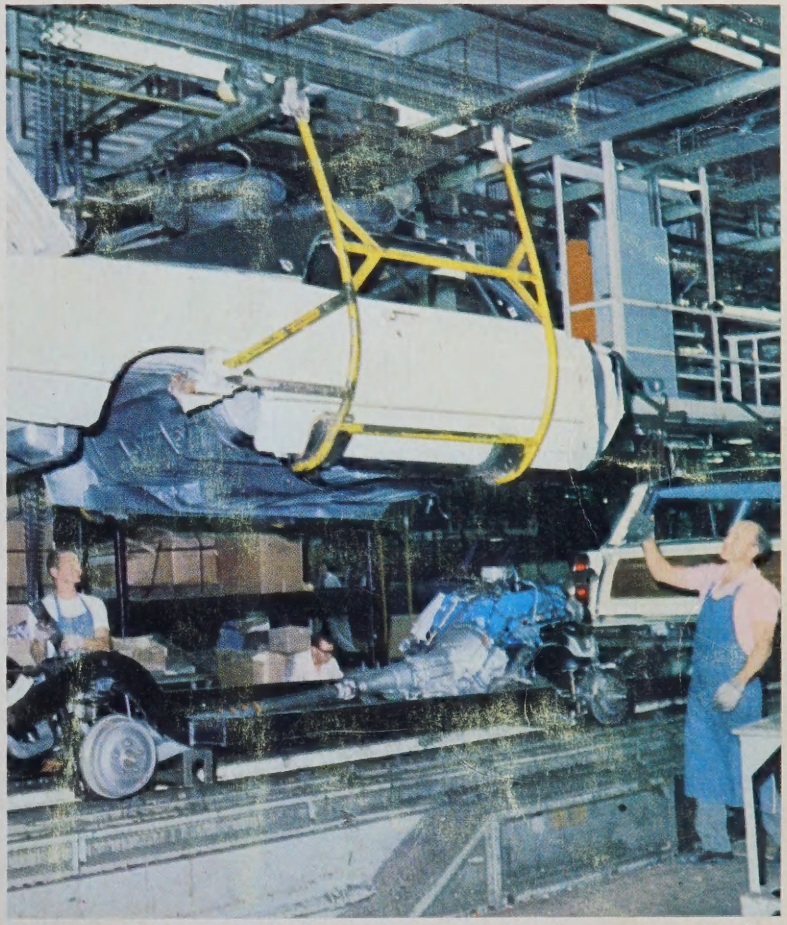
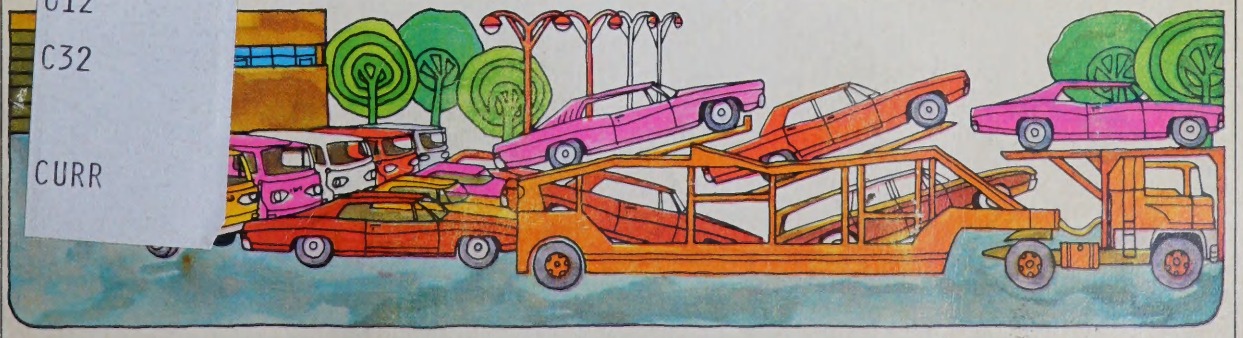
ssembling automobiles

at Oakville





assembling automobiles
at Oakville

by Lorne R. Carson

Manufacturing

Automobile assembly

This case study of manufacturing deals with an automobile plant. It could be the story of any manufacturing industry. Our selection was made, however, because an automobile plant provides an excellent example of (1) automation in industry; (2) flow of materials into the plant; (3) control of materials within the plant. An added reason, of course, is that everyone can look forward to owning an automobile. They affect the lives of everyone.

For purposes of our story, it is considered best to select one company for study. Our selection happens to be Ford Motor Company of Canada, Limited, located at Oakville, Ontario, on the west shore of Lake Ontario, midway between Toronto and Hamilton. In Ontario the selection might have been American Motors, Brampton, or Chrysler or Jeep Motors, both of Windsor, or General Motors, at Oshawa. Many of the ideas, or concepts, that you will learn will apply to all industries.

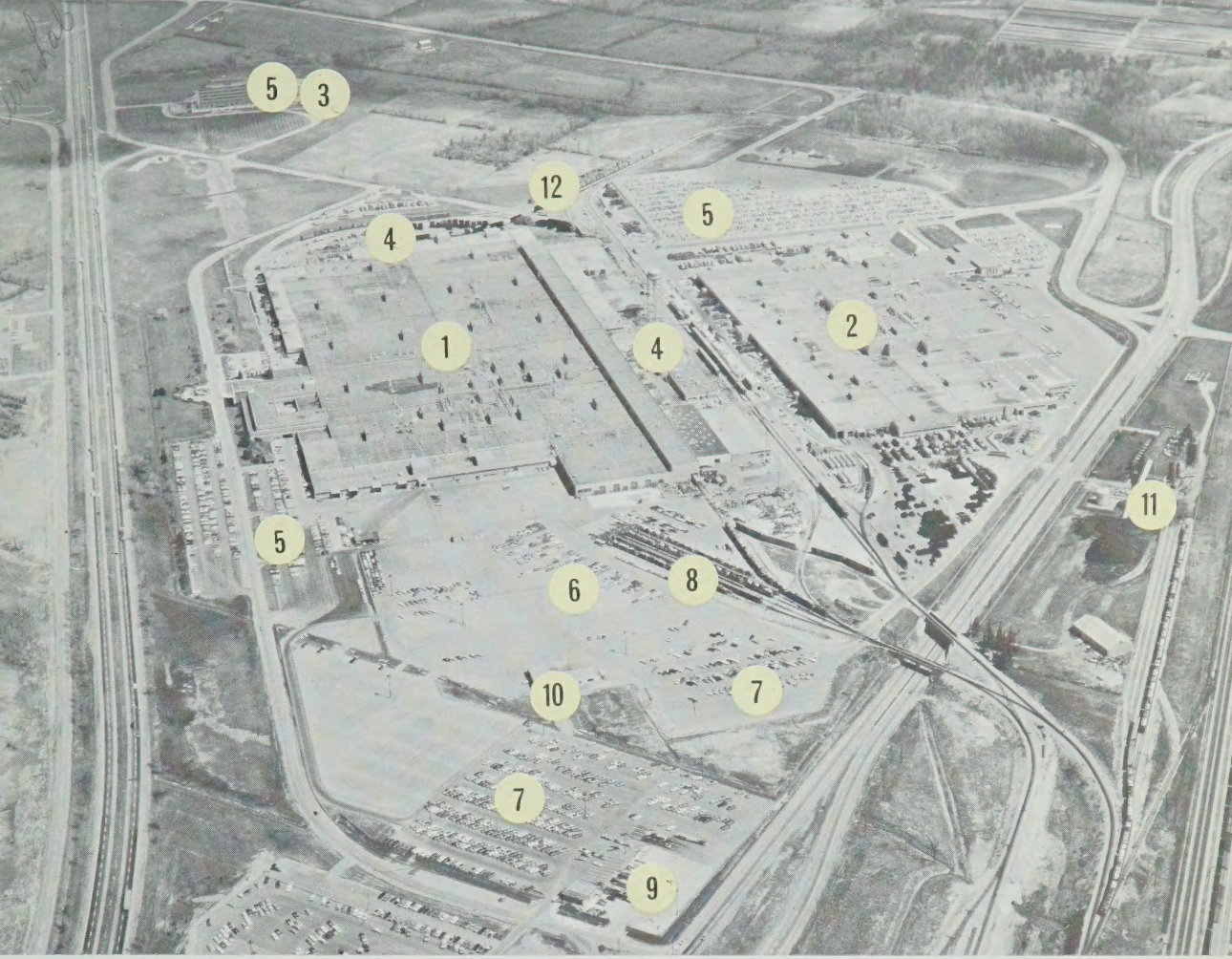
Ford of Canada's Oakville Assembly Plant

Ford of Canada's Oakville Assembly Plant is the largest factory building in Canada. We will study its exact location, the process of making cars, and the reasons why Oakville was chosen as the site for the plant. Many of the reasons which helped Ford of Canada decide to build its plant at this location are true for other firms, and have made this area one of the fastest-growing parts of Canada.

DO

1. Find Oakville on the map below.
2. Measure the distance by land from Oakville to (a) Toronto (b) Hamilton (c) St. Catharines.

The shaded area is the main industrial region of Ontario. Why is it called the "Golden Horseshoe?"



Lockwood Survey Corporation Ltd.

1. car plant
2. truck plant
3. administration building
4. parts reception
5. employee parking
6. new car parking
7. truck parking
8. tri-level area
9. haul-away truck loading area
10. pass gate to truck area
11. power plant
12. railway cars

DO

1. Find the main highway on the picture. From the topographic map on page 4, identify this highway.
2. Find the main railway line. Trace the spur lines from the main line (use the topographic map to assist you). Follow the spur lines into the plant and name the areas of the plant served by these lines.
3. Look at the photograph and say why this land is suitable for a manufacturing site.
4. From other evidence on the photograph, suggest how this land was used before Ford of Canada built here. Which use of the land is more valuable to the economy? What was the natural vegetation of this area?

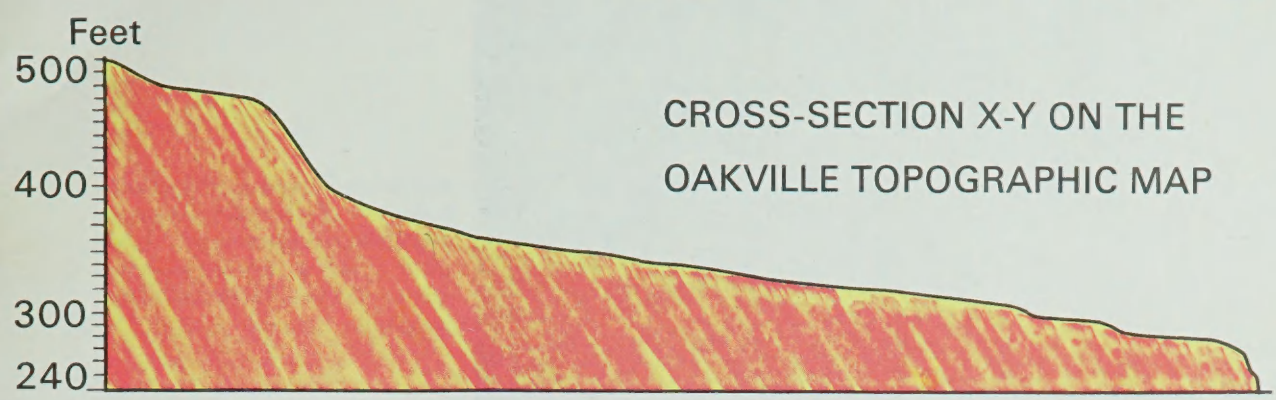
OAKVILLE, Ontario

Orchards

Buildings

Schools

SCALE 1 mile 2 miles



This "cross-section" shows the land along the line X – Y on the map as if you were looking at it sideways. Copy the cross-section on a piece of paper. Fit it along the line on the map and mark in (a) the factory; (b) the Queen Elizabeth Way; (c) the railroad and (d) the orchard.

DO

1. A geographer uses the word "site" to describe the actual land on which a building, town or place is located. Using the map and picture on page 3, describe the site of the Ford plant.
2. On the map on page 4, use the scale to find how far the car assembly plant is from (a) the park in Oakville; (b) from the closest part of the Lake Ontario shoreline.
3. The red lines on the map are *contour* lines joining points of equal heights. What is the height of the shoreline of Lake Ontario above sea level? What is the height above sea level of the Ford plant? How much higher is the plant than the shoreline? Find the highest point on the map.
4. Locate on the map (a) the oil pipeline; (b) orchards; (c) a river valley.

Assembling the Car

You have now seen what the assembly plant looks like, and you know where it is. For a close look at how cars are assembled we shall go inside the plant and watch a new car being put together along the miles of assembly line at Ford's Oakville Assembly Plant.

What kind of car shall we watch? A family sedan? A large luxury car? A station wagon? A convertible? We shall see them all.

Almost every car is ordered from a dealer on a form which is filled out to suit any of the cars mentioned. The dealer may order cars which he thinks he can sell, or he may order cars to suit each individual order. Why do you sometimes see a dealer's lot full of unsold cars?

Let's start at the beginning of the assembly line and follow the cars on their journey along the 13 miles of assembly line.

Railway flat cars bring the frames to Oakville. The flat cars are shunted onto sidings in the storage area to await unloading. In the picture on page 3, find the most likely storage area for these frames.

The Assembly line

From frame to chassis

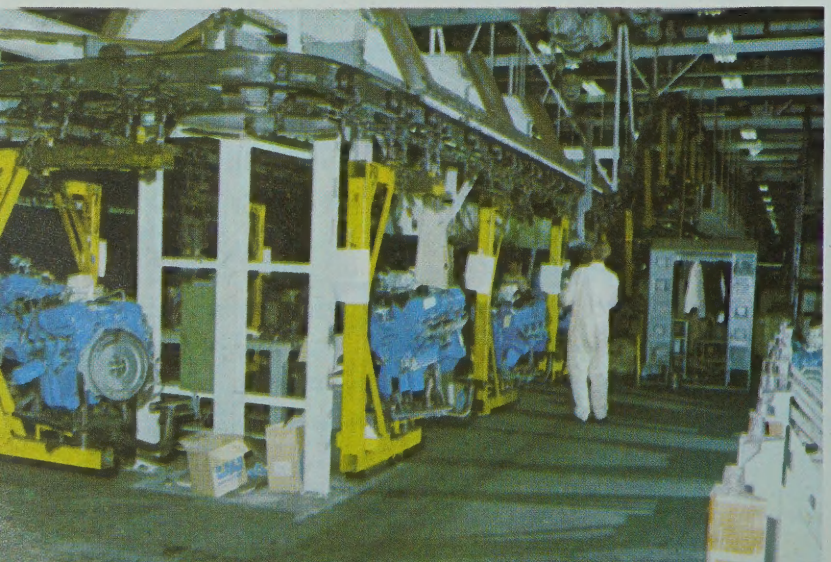
The car starts its trip as nothing more than a sturdy frame. These are delivered from one of the plant's enormous storage areas. From other storage areas come the parts needed to build each type of car ordered. *Production control* makes sure that the correct parts reach the assembly line in the correct order.

As the frame moves along the assembly line, workers quickly add springs, axles, brakes, bumpers, wheels, the fuel tank, and the engine. The engine, which arrived already partially assembled from the storage area, was *decked* or installed on the frame by men using powerful machines which easily handle the lifting of heavy engine and transmission units.

What we have now is called the *chassis*. This is the mechanical, working part of our car, but it is certainly not a car yet. Let's go back to the start of the body assembly line to watch the outside of the car take shape.

The body

The floor, roof and side panels are held in place by special framing fixtures called *bucks* or *gates* while the parts are welded together. It is like a small fireworks display



The engines start on their subassembly line. Note the sheet of paper from production control on each engine stand. What information would be on this sheet? Where will the engines go when their assembly is completed?

Much of the body welding is done by automatic machines, but some must be done by men. What advantages are there to a welded body rather than one bolted together?

Ford of Canada

to watch the sparks flying from the smoothing grinders and the welding torches. Much of the welding is done automatically by machines.

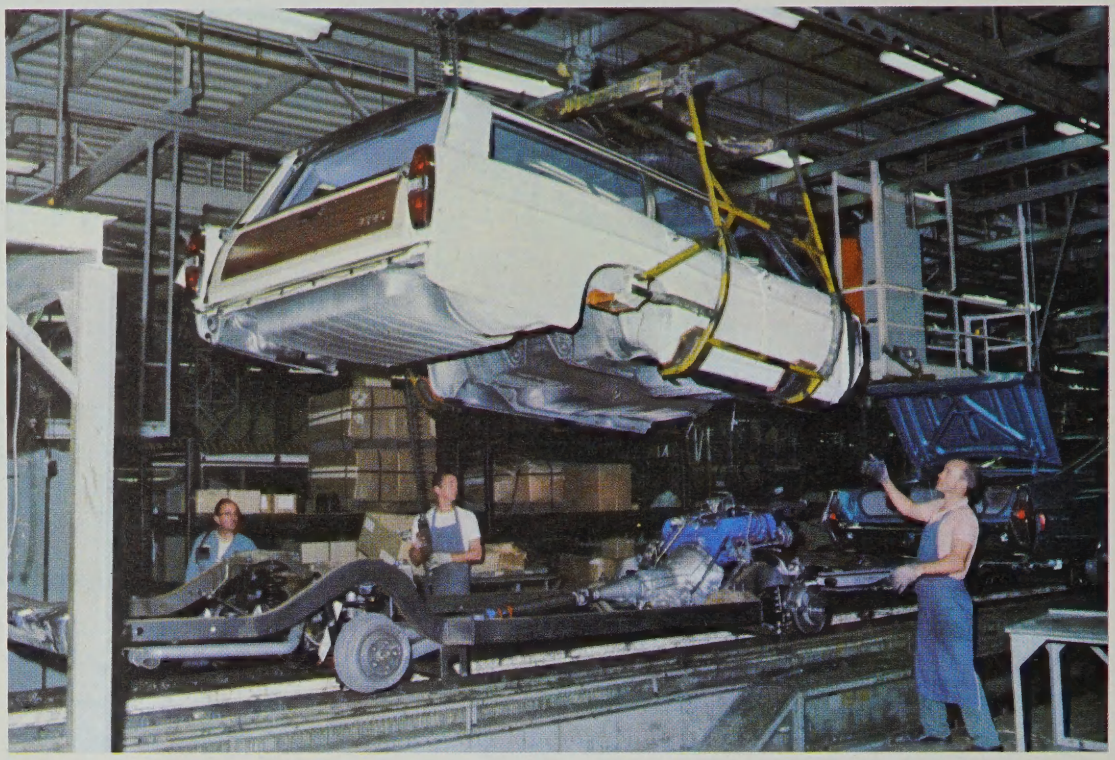
The car doors and trunk lid are added next. All metal surfaces are ground smooth, and the body thoroughly cleaned. Though many parts are still missing, it is quite easy to tell what kind of car this body is for.

The unfinished body is now carefully examined. Large, accurate machines also check it before it is allowed to go to the paint shop.

A yellow car is followed by a red station wagon. What would happen if the paint shop accidentally switched the painting directions for the station wagon and the car? Why is production control important here?

Ford of Canada

Using the text and the chart on page 10, tell what stage on the assembly line these bodies have reached. Try to identify spare parts stacked in the background. What body types can be identified in the foreground?



The man in the center holds the controls for the assembly line. He keeps control of the body until it is properly adjusted on the chassis. The next body cannot come around until he releases this control. What parts of the chassis can you name?

In the paint shop the car receives a primer coat and several coats of the shade that has been ordered. The body then moves to a large oven where the color is baked to a bright, hard shine.

When the paint is dry, the body is *trimmed.* Wiring, upholstery, glass, instruments, chrome, and all handles, knobs and buttons are installed, so that the body is ready to meet its chassis.

The body meets the chassis

Large, padded hooks now lift the body onto the assembled chassis. Production control again assures that the right body meets the right chassis at the right time. The body's front end is added, and when these sections have been bolted firmly together, the hood is attached. Seats are installed, and we are at the end of the assembly line. At this point, the car is tested to see that it is water-tight. It is deluged by water, and then carefully examined for any places where leakage could occur.

Now that the car is complete, a driver arrives and takes it to the final inspection line. During the assembly operation, the car has been tested at many points, but it is checked again to make certain that there are no flaws. If all the inspectors pass the car, it is driven out to an enormous parking lot to await shipment by train or truck to the dealer who ordered it.

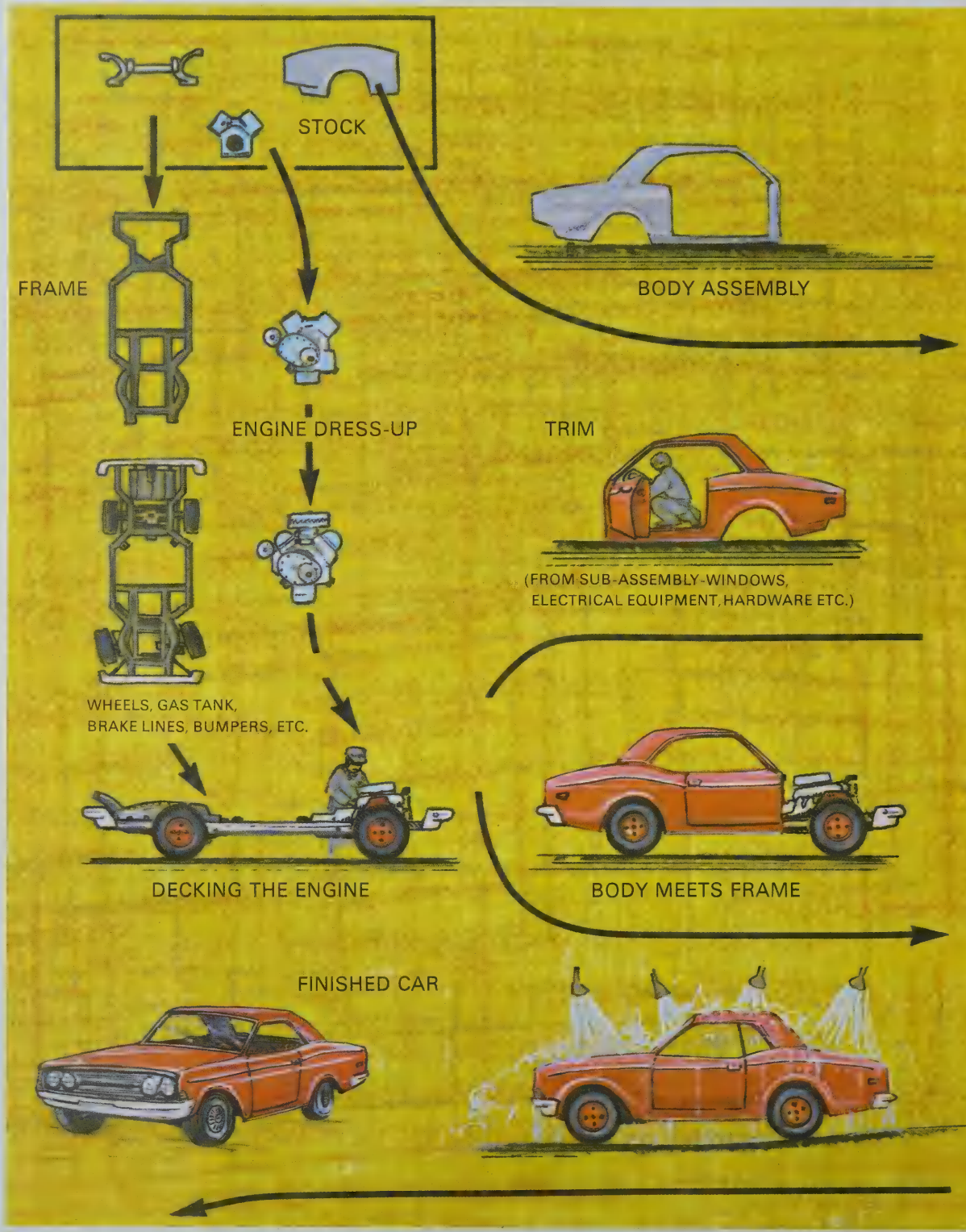
What remains to be added to the car after the front end subassembly is attached?

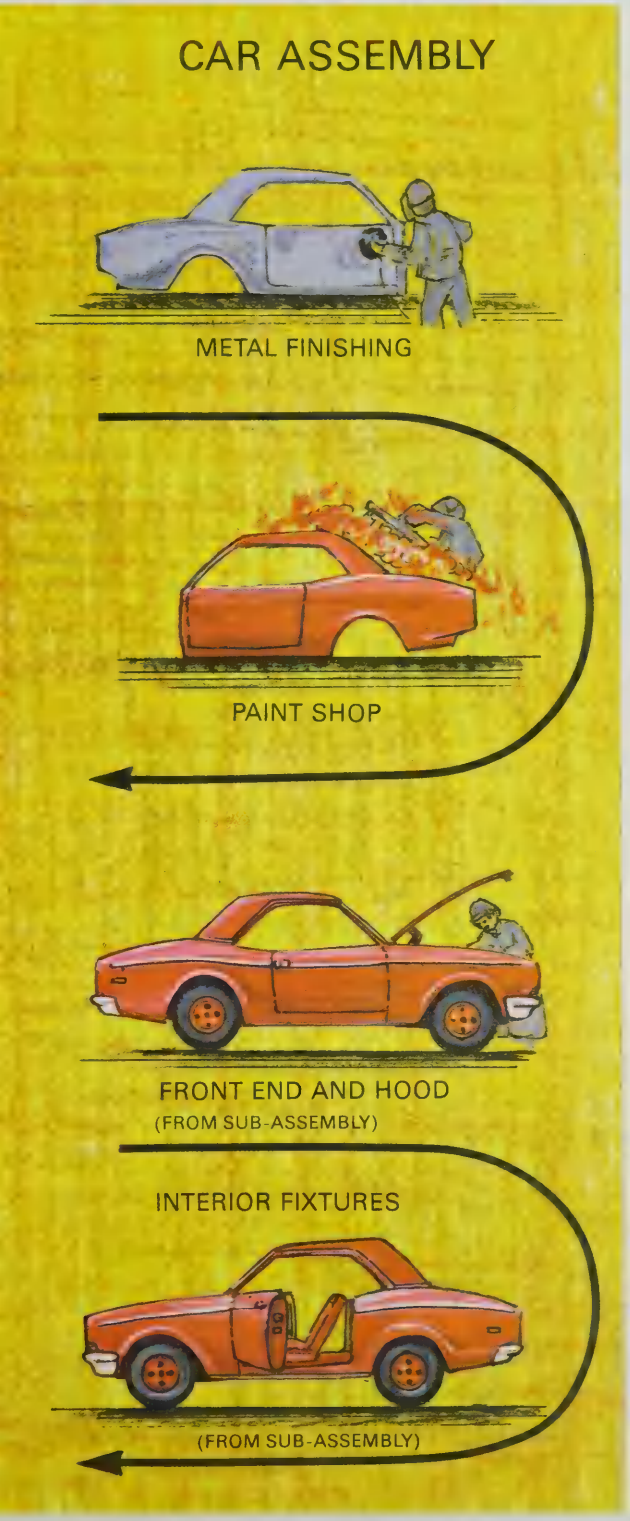
The Oakville plant can produce a maximum of 840 cars a day during peak production. There is continual movement in and out of the parking lot. Cars are being delivered from the production line, being loaded on railway tri-level cars, being loaded onto haul-away trucks – cars are everywhere!

DO

Look carefully at the picture above and describe how it illustrates (a) automation; (b) production control and (c) an assembly line.

Find this area in the photograph on page 3. What factors might cause the new car parking area to overflow? What would have to be done to reduce the numbers of cars?

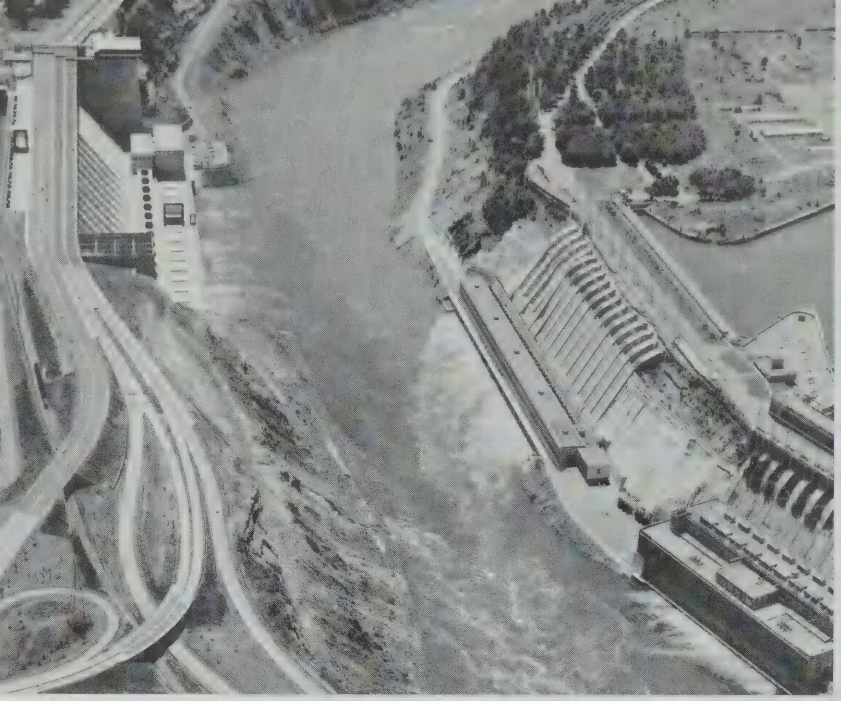

STOCK
FRAME
BODY ASSEMBLY
ENGINE DRESS-UP
TRIM
(FROM SUB-ASSEMBLY-WINDOWS,
ELECTRICAL EQUIPMENT, HARDWARE ETC.)
WHEELS, GAS TANK,
BRAKE LINES, BUMPERS, ETC.
DECKING THE ENGINE
BODY MEETS FRAME
FINISHED CAR



The chart opposite is not an actual plan but is a simplified version of the flow of materials through the plant.

DO

1. Using the diagram, explain why the Ford plant is called an "assembly" plant. Write down at least four other manufactured products made by "assembling" parts.
2. Why is an assembly line an advantage to modern industry? The chart opposite will provide some answers for you.
3. From the diagram and text, explain why stockpiles of parts are not all kept in one storage area.
4. Is the assembly line shown here truly one line? Explain your answer.
5. From the chart, give as many examples as you can of automated machinery assisting man.
6. Follow the assembly line and suggest at what point the most hand-labor is used, and tell why you chose this point.



Canadian and American power houses at Niagara.

Canadian Govt. Travel Bureau

The Importance of Location

Physical factors

Many factories have grown almost by chance. A small business was successful, the owner hired more employees, bought neighboring buildings to expand, and gradually increased in size.

The Oakville Assembly Plant, however, was started quite differently. In the late 1940's Ford of Canada, which already had a factory at Windsor, needed a new plant in Canada. The company decided that Oakville would be the best choice.

What factors make Oakville a suitable location for automobile assembly?

You have already seen that the site of the factory is flat and suitable for construction purposes. This was an attractive feature of Oakville.

Water

The company needed a location with plenty of readily available water. The Oakville plant has a pipeline extending 2600 feet out into Lake Ontario, through which millions of gallons of water flow each day to a lake-shore pump-house. Then it goes to a boiler house situated about 1200 feet from the plant. Steam produced in the boiler house is used for heating the plant, cleaning and processing, and for supplying compressed air to drive thousands of the tools used in assembly operations.

Power

Electric power, used extensively in the plant, is supplied to Ford's Oakville operations by the Ontario Hydroelectric Power Commission. Much of this power is produced at Niagara Falls, 70 miles away around the western end of Lake Ontario.

Southern Ontario

The reasons given so far for the assembly plant's location are valid, but they do not by any means tell the whole story, for many areas around the Great Lakes have sufficient water and electric power for an auto plant.

DO

1. Using the map on this page, find 5 towns which might be as suitable as Oakville in this respect. Remember that the Ford Assembly Plant used to be located at Windsor, Ontario. What advantage would Windsor be for an automobile plant?
2. Start a list of the factors which are important in locating an industry.
3. Trace the ridge of land from Owen Sound to Niagara Falls. This is known as the *Niagara escarpment*. What relation has the escarpment to the Niagara power development?
4. Trace four possible routes by which parts could come from the United States to the Oakville plant. How would parts come from Ontario cities?

Actually, of the factors which combined to locate the assembly plant at Oakville, *physical* geography was among the least important. Above all, Ford of Canada wanted a location which would allow it to assemble cars near to the biggest Canadian car market.

In order to find the best location, Ford's planners had to answer the following questions:

1. Where will the assembly workers come from?
2. Where will the materials used by the plant come from?
3. Where will the finished cars be sold?
4. Where is land available at the right price?

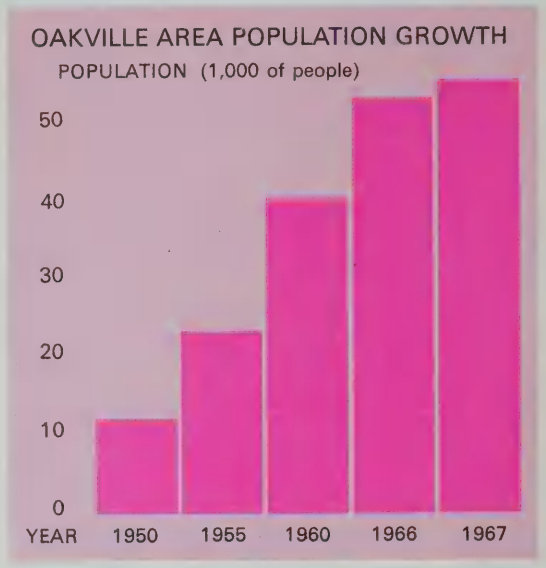
After a great deal of research, it was decided that Oakville was the most promising location. Let's see why.

Workers

When the assembly plant was built in 1952, there were few people who lived there likely to take up this occupation. The Oakville area is, however, connected by excellent highways to the large population centers of Toronto and Hamilton. Because of the nature of car assembly, workers could become skilled fairly quickly at their new jobs, and a strong labor force was quickly and easily built up. Good wages helped to attract these workers; in 1968, the Ford workers' average working week was 40 hours, while the average weekly wage was $125.00.

Study the map on page 13 to find where the assembly workers come from. Today, while many Ford employees live in Oakville, most of the 6900 workers commute from homes in Hamilton, Toronto and their suburbs. Some live as far as 65 miles from the plant.

Oakville is served by both buses and commuter trains, but most of the employees come to work by car. Often they share rides with friends. Thus the Ford company has a supply of workers who are good customers for the cars they make.



Does the graph show that Ford of Canada's plant influenced the growth of the Oakville area?

The Ford's Oakville Assembly Plant opened in 1953, but the growth of the Oakville area is part of the very rapid increase in population of the area known as the Golden Horseshoe.

Parts supply

The materials used in an automobile assembly plant are always in the form of finished parts. These parts are supplied to the plant by hundreds of different manufacturers, who make them from a great variety of raw materials. A finished car, for example, contains more than 100 types of steel. The diagram on page 17 shows how some raw materials are used in car production. For the complete story of the metal in the roof of a car, for example, it would be necessary to begin with the mining of raw minerals. Then we would go through the steel mill where metal sheets are made. From there we

would follow the sheets to the manufacturing plant where they are stamped into car roofs. Then we would follow them to the assembly plant.

It would be impossible here to describe the manufacturing of all the parts. We will examine two major operations; the general methods used in the making of metal parts and the manufacture of an engine. These will be useful examples for further research on how other parts are manufactured.

Making metal parts

Each metal part must be shaped accurately and is formed by one or more of three main *forming operations.*

i) One is the *foundry* or *casting* operation. Here the part, such as an engine block, is formed by pouring molten metal into a mould, where it hardens into the desired shape. Can you think of other parts of a car that might be made this way?

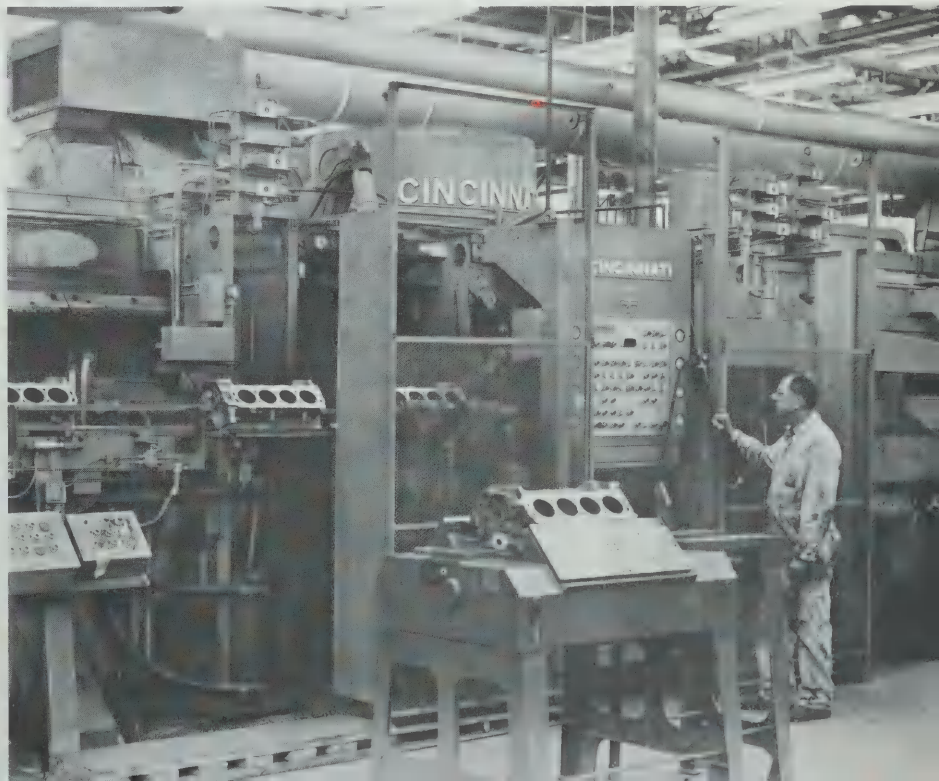
ii) A second operation is *machining.* In this, the cast part is shaped further by tools which cut away unwanted metal.

iii) A third operation is *stamping.* Here parts such as the roof, side panel or fenders, are formed by pressing, or stamping, metal sheets into the desired shape. Huge *presses* come together on the sheet of metal, cutting it into the exact pattern, piercing holes wherever required, and finally pressing it through a series of movements into the finished form.

The engine

The making of a separate part, such as an engine, can be a huge industry in itself. When the engine block arrives at the manufacturing plant from the foundry, it is a rough iron casting. To complete the work on this casting and change it into a working engine requires more than twenty different automatic machines. These machines do a

Ford of Canada



This is one of the huge pieces of equipment which machines engine parts. What advantage do machines have in doing work? Would this machine need more than one man to maintain it?

How does this photograph illustrate mass production? It also shows an idea we will discuss later—automation.

Ford of Canada

total of over 600 separate operations. Some of these machines can do 100 operations in 30 seconds. The engine blocks move along a line where machines automatically perform their drilling or cutting operation. In much the same precision manner, the working parts of the engine, such as pistons or fuel pumps, are put in place by workmen as the engines move past them.

Where something is manufactured in great numbers, such as an engine, or a car, we call it *mass production.* All parts of a car, as well as the car itself, are mass produced.

Transportation

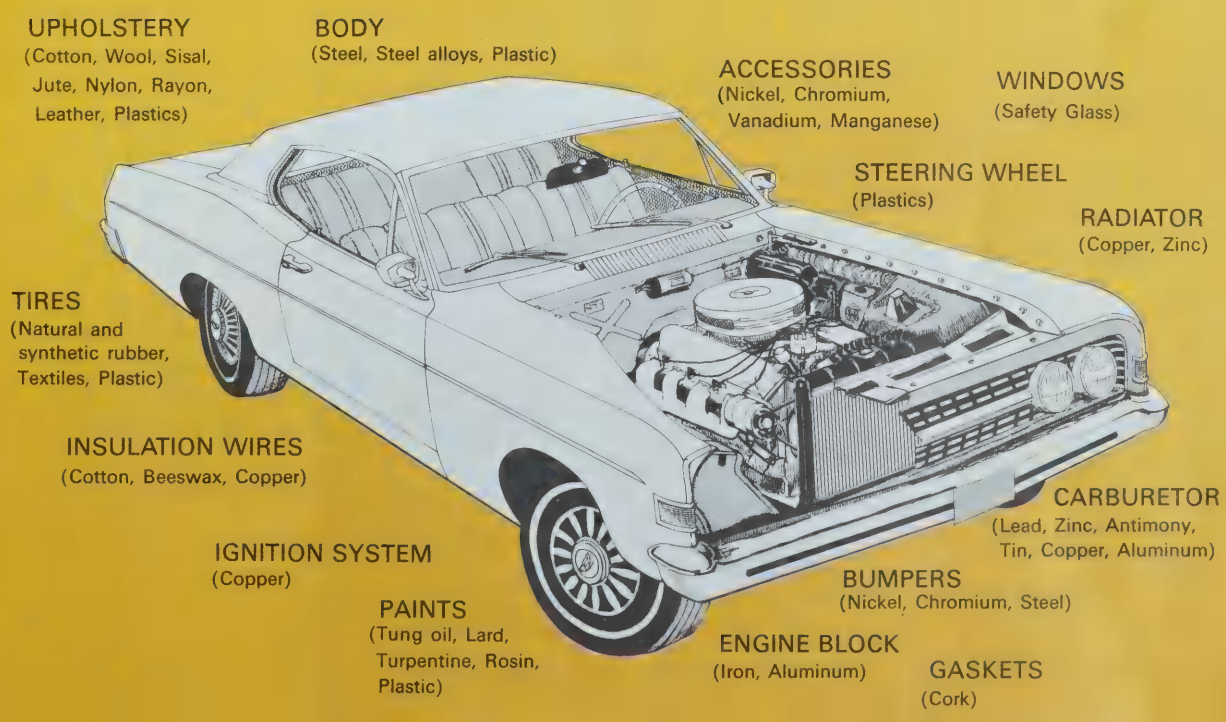
Every car produced on the Oakville assembly line contains about 15,000 parts. Since every one of those parts must be sent to Oakville from the factories of hundreds of supply firms, it is easy to see why the cost of transporting materials is one of the company's major expenses. Parts generally come from Michigan, New York, and Ontario. The principal Ontario cities are Toronto, Hamilton, Windsor, Kitchener, St. Catharines and Niagara Falls. Some parts arrive by train, but it has been found that in most cases, tractor-trailers provide the most economical method of transport.

Ford usually keeps a five-day stock of parts on hand to ensure smooth operation of the assembly line at Oakville. Delays in parts shipments may be caused by labor strikes at the supply firms, or else by natural causes, such as heavy snow, which might restrict truck movement.

What are the advantages of bringing the railway cars into the building?

DO

1. Make a list of as many raw materials as you can find on the diagram (example—nickel). Which would be the most important?
2. How many processed materials can you find on the diagram (example—plastic)?
3. What happens to all this material when the car is abandoned?
4. Discuss additional ways that parts might be delayed in shipment between a supplier and the Oakville assembly plant.
5. Add to your list of locational factors.



Can you explain why tri-level railway cars sometimes carry twelve cars and sometimes fifteen cars? If these cars are going to B.C. why is it preferable to ship by rail?

Markets

Twenty percent of all motor vehicles sold in Canada are marketed within 200 miles of Toronto. It was obvious to Ford of Canada's planners that they should move as close as possible to that city. Why would they not consider the construction of an assembly plant within the city of Toronto itself? Oakville was an excellent solution to the problem: the area is close to Toronto yet land was cheap enough, and transportation routes were already well-developed. Oakville is connected by both rail and highway to Hamilton and Toronto. A Canadian National railway siding branches off a major East-West rail line in order to handle traffic from Ford's Oakville operations. You have already noticed how many modern highways serve the area.

If these cars are going to Kingston Ontario, why are they going by trucks?

DO

1. Examine the air photograph on page 3. Count the number of rail lines which service the plant. Why does Ford of Canada not use these rail lines to bring in workers?

Seventy percent of the cars produced at the Oakville assembly plant are shipped out to the market on large triple-deck railway cars. The rest are loaded onto trucks designed to carry two levels of finished cars. You have, no doubt, seen many of these heavy trucks delivering cars to retail car dealers. Watch for these trucks and count how many cars one truck can carry. Each 3-deck railway car can carry 12 to 15 finished automobiles.

Ford of Canada makes cars which it sells to dealers, who retail them; that is, who sell the cars to the general public. If you were to buy a new car, you would get it from a dealer who would order it from the automobile company. The dealer's order would be filled at the assembly plant, and the finished car sent out by rail to a regional distribution center, where it would probably be put on a truck for final delivery. Ford of Canada has six of these regional centers to serve all of Canada.

Many of the cars made in Oakville are sold outside of Canada. In fact, up to 60% of Canadian car production goes to the United States, but figures vary from year to year. Several regional centers in the U.S.A. distribute these Oakville cars all over the country.

Consulate of Japan, Toronto

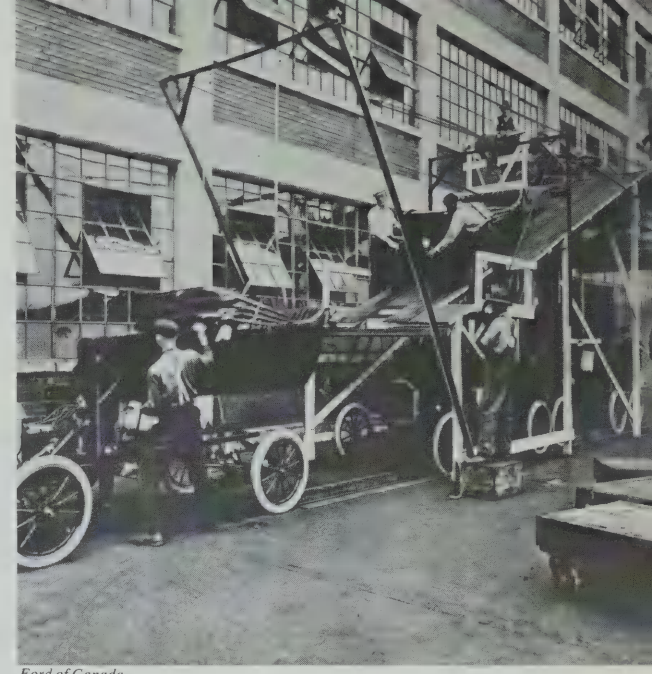
Why are <u>women</u> more satisfactory for this type of assembly work?

Mass Production and Automation

The idea, or principle, of mass production may be traced back to 1800. At that time, the United States was in danger of war with France and needed 10,000 muskets within a very short time. Up to that time, each gun was made by hand by a gunsmith who fitted each part together. Even by getting all the gunsmiths together, it would not be possible to produce enough guns in the event of war.

It was at this time that Eli Whitney led the way to mass production through manufacturing guns. Instead of making guns by hand, Whitney built machines that duplicated gun parts (turned out parts the same). With the parts made, only the fairly simple work of assembling them remained. What happened, in effect, was that the skill of hand-making guns was put into the hands of workmen whose job was to operate the machines that make the parts. Not only were guns now produced in great numbers and of superior quality, but any damaged part could be replaced. Previously, the parts of a handmade gun fitted only that one gun. Now the mass-produced parts could be interchanged with any gun made up of these parts.

It was not until 1900, one hundred years after Whitney's work, that Henry Ford introduced mass production methods to the automobile industry. Today, the total making of a car, both the parts and the car itself, is perhaps the best example we could find of modern mass production.



Ford of Canada

The body meets the chassis on Henry Ford's first production line. Compare this picture to the one on page 8. What features are similar? What features are different?

There are four main principles applied where an article is mass produced. They are:

Uniform parts
Automation
Division of Labor
Saving of Effort

Uniform parts means that any one item, of thousands manufactured, is exactly the same as the original and will fit together with another item with which it is required to work. For example, when a metal bolt with a certain thread is manufactured, and a nut then manufactured which would screw onto the bolt, any nut or bolt from among the millions of the same design will work with one another. In the case of an automobile, any wheel, for example, will work on any axle for which it was intended. This same principle applies to all of the parts used in the making of a car.

Automation we saw at work in the making of an engine. Much of the machinery is automatic. Through automation in any factory, nearly all of the work of lifting, lowering, and moving of parts, is done by power conveyors. The movement of these conveyors and the parts they carry, is, in turn automatically controlled, often electronically.

Work, in effect, is taken to the men and machines, not men and machines to the work. This movement of parts is a continuous flow; a flow that has many tributaries into main streams but one that is planned and orderly.

Division of Labor means the breaking up of a big complicated job into small parts. It has been found that a task, such as making an automobile, is easier and can be done more quickly if the work is divided into simple little jobs. Each of these little jobs is done by a different worker.

Saving of Effort is the idea of reducing time-wasting movements by the workers. For example, parts of a product to be assembled arrive waist-high at the worker. Not often does a worker have to stoop down to pick up a tool. As nearly as possible, all work is done in one movement with very little walking.

DO

1. What advantage is there in a machine doing work?
2. What disadvantages does a machine have?
3. What problems does automation have for workers?

Effects of Mass Production

Let us see how these principles affected the production of automobile engines.

The old way was to have one man assemble the whole engine, walking around and around it until it was finished. The new way broke the work into 84 parts with one man to each part. All 84 men stood still with the work moving past them waist-high, each man having to do just one thing. The result: 84 men now assembled 352 engines — or four times as many in the same length of time.

Just as the four principles of mass production are used in the making of cars, they can also be applied to the assembling of any product.

Explain the role of production control here.

Production

Ford's production graph for 1967 shows three drops in production. The October drop was caused by a shortage of parts when there was a strike in the American Ford plants. How long could the Oakville plant produce cars after supplies ceased to arrive?

The August drop in production occurs each year when model changes are introduced. At this time, the assembly line machines must be retooled (changed) to suit the new models.

Why do many car manufacturers change the styling of their cars each year? Is it a result of public demand? How does it affect the price of a car? Is it necessary, do you think? How do you account for the March slump in production? Is there a best time of year to buy a car?

Planning a New Model

The planning of a new model starts three years before the car reaches the dealer's lot. Styling specialists, engineers and accountants, who analyze the costs, are all involved in the changes to be made. The stylists decide how the car should look, then hand their designs to the engineers, who draw up the plans. When the plans have been approved by the accountants, a *prototype,* or first type, of the car is made. This is an experimental car which includes all the new ideas and styles which have been decided upon. All parts of the model are hand-made and thoroughly tested. When the car is assembled, it is tested for performance. It is run over all kinds of roads, checked for its

The body frame of the Morgan car is being fastened together. Contrast this picture with the one on page 7.

Ross Bateman

ability to take corners safely, to accelerate, to brake properly and to steer properly. The final test is for its ability to withstand crashes. Finally, the model is taken apart and all the parts tested to find out how they stand up to the wear and tear of driving. So you can see that before a new model goes to the production line, all the major tests have been made on it, and all the major sources of trouble found and corrected.

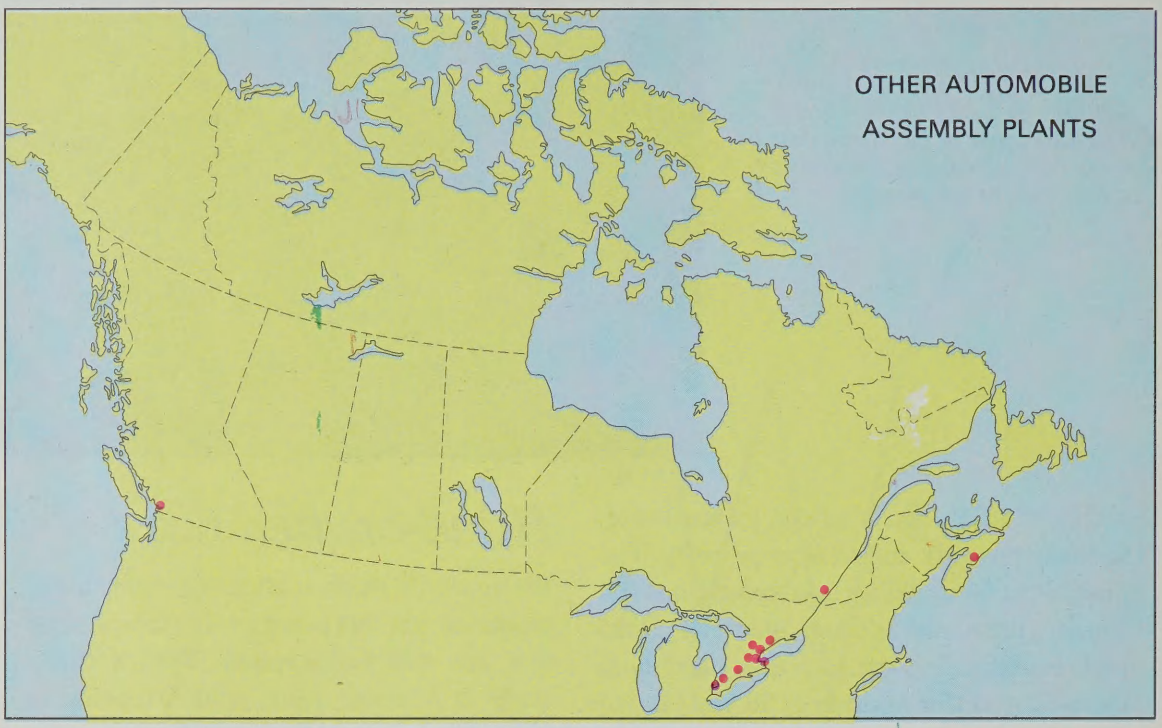
There are some manufacturers who make few or very small changes in their car models. Think of one example you often see on Canadian roads. What advantage is it to the manufacturer and the consumer to make few changes?

Hand-crafted Cars

We generally think of all cars as being mass-produced, but this is not so. In Europe some cars are still hand-crafted. Such a car is made at Malvern Link, near Worcester in England, by the Morgan Company. The body frames, made of wood, are cut out in their own carpenter shop, which is in one of seven buildings which make up the plant. The metal body is nailed to the frame. Each nut and bolt is placed by hand. The company is successful, although they produce only about nine cars a week. This is because there is very little equipment needed, and the buildings were paid for long ago.

Ross Bateman

This man is smoothing the joints in preparation for the paint shop.



DO

1. Find a map showing where people live in Canada. (population distribution). Now look at the map above, and using the information in this study, suggest the reasons for the location of auto plants.
2. Look at the map and find one auto plant location where these reasons do not apply. Find how the plant came to be built here.
3. Automobile assembling is known as a secondary industry because it uses materials which have already been processed, such as rubber tires. The steel industry is known as a primary industry because it uses raw materials such as iron ore. Compare locational factors for the two industries. (See Ginn study on Making Steel in Hamilton).
4. Visit a local industrial plant in your neighbourhood, and find out (a) if it is an example of primary or secondary industry; (b) the reasons for its location, using the factors we have discussed.

For additional reference see National Film Board filmstrip Great Lakes-St. Lawrence Lowlands-Steel and Automobile-36100.

Ginn Sample Studies of Canada